as on Fahrenheit's original scale, so that the scale now known by his name differs slightly from that originally defined by him. Two of his original instruments are in the Physical Laboratory at Leyden; the freezing points as now given by them are at 34°·2 and 34°·1 respectively; both of these are mercury thermometers.

After Fahrenheit's time came various imitators, each with his own special scale; for an account of them we must refer the reader to Mr. Bolton's pages. Among them the scales of Réaumur and of Celsius alone survive, though, as Mr. Bolton points out, Celsius proposed to call the boiling point of water 0° and its freezing point 100°; the change to the present centigrade scale was made independently in 1743 by Christin, of Lyons, and seven years later by Strömer, a colleague of Celsius at Upsala.

Réaumur's choice of 80° for the temperature of steam was made as a result of his experiments on the expansion of alcohol. He found that alcohol, diluted with one-fifth water, expanded in volume from 1000 to 1080 when raised from the freezing point to the boiling point.

Mr. Bolton is to be congratulated on his work. He has made it most interesting, and it deserves many readers; it suggests the hope that some one may take up similarly the history of other physical instruments and write about them in as bright and capable a manner.

THE OXFORD TEXT-BOOK OF ZOOLOGY.

A Treatise on Zoology. Edited by E. Ray Lankester Part II. *The Porifera and Coelentera.* By E. A. Minchin, G. H. Fowler and G. C. Bourne. With an introduction by E. Ray Lankester. Pp. x + 405. (London: Adam and Charles Black, 1900.)

THE second part of the "Treatise on Zoology," now appearing under the editorship of Prof. Ray Lankester, contains six chapters, the work of four different authors, graduates of the University of Oxford. An introductory chapter by the editor, on the Enterocœla and Cœlomocœla, deals with the main divisions of the Metazoa; Prof. E. A. Minchin writes on the Sponges; Dr. G. H. Fowler on Hydromedusæ and Scyphomedusæ; and Mr. G. C. Bourne on the Anthozoa and Ctenophora. The high character of the whole work, of which the volume previously published (Part III. Echinoderma) gave promise, is fully established by that now before us, and it can scarcely be doubted that this treatise will, for some time to come, be regarded as the standard English text-book for advanced students of zoology.

The classification of the Metazoa adopted by Prof. Lankester in the introductory chapter is based upon the work of the most recent writers on animal morphology, and differs in several ways from that previously adopted in the text-books. The whole animal kingdom having first been divided into two grades, the Protozoa and the Metazoa, the grade Metazoa is considered as giving rise to two branches, the Parazoa, or Sponges, and the Enterozoa, the latter name being a term previously introduced by Prof. Lankester as a substitute for Haeckel's term Metazoa, but which he now proposes to restrict to the second great division of the Metazoa. The view thus adopted of the position of Sponges in the animal kingdom is that advocated by Minchin in the present work (see p. 158); but, as that author points out, it is one which is by no means accepted, at the present time, by other leading authorities on the morphology of the Porifera.

After this main division of the Metazoa, Prof. Lankester proceeds to divide the Enterozoa into two branches, the Enterocœla, or those in which the sole cavity is the enteron, and the Cœlomocœla, those in which the cœlom is present as an independent second cavity. It is certainly open to doubt whether any advantage is gained by the introduction, in a work of this character, of these new terms to replace the already so widely used Cœlentera (or Cœlenterata) and Cœlomata. Indeed, Prof. Lankester himself appears to regard his new nomenclature as tentatively put forward for the consideration of his fellow morphologists, for it is not even adopted in the present volume. The title-page bears the name Cœlentera, and this is the term used both by Mr. Bourne and Dr. Fowler in their sections of the work, the latter writer making use also of the form Cœlenterata (p. 60), to which the editor of the treatise takes exception.

The remaining portion of the introductory chapter gives, in a clear and interesting manner, an account of the author's views with regard to the cœlom and its relations to the other cavities of the body in the different phyla of the Cœlomata (Cœlomocœla), together with a detailed history of the progress of our knowledge of that organ. The discussion of this subject is noteworthy on account of the particularly clear statement of the author's theory of the body-cavity relations found in the Mollusca and Arthropoda. According to this theory, now termed the theory of Phlebœdesis, the true cœlom is present in these groups in a reduced form, whilst the blood-holding spaces (hæmocœl) are in reality swollen blood-vessels. In support of this view, Benham's work on *Magelona* (*Quart. Journ. Micr. Sci.*, xxxix. 1896) is brought forward. The concluding part of the chapter is of interest from the great importance attached to the recent work of Meyer and of Goodrich on the nephridia and cœlomoducts of the marine Chætopoda, the views of these authors being entirely adopted, notwithstanding the fact that they revolutionise the prevailing ideas on the subject, ideas which owe their origin very largely to Prof. Lankester himself.

Prof. Minchin's section on the Sponges, we have little hesitation in saying, contains the most successful account of an animal group which has yet appeared in this treatise. It is in many ways a model of what such a general account should be, and is certainly the most satisfactory summary of our knowledge of the Porifera which at present exists in any language. It is by no means merely a compilation and discussion of facts already put on record by other authors. Much new matter is here recorded for the first time—notably the account of the development of *Clathrina blanca*—and a large part of the descriptive portions of the chapter is the direct outcome of the author's own observation and experience. Prof. Minchin's work as a histologist, which has shown him to be an expert in the most recent and delicate methods of technique, is well known, but the present article proves him to be at the same time a painstaking and observant outdoor naturalist. That a sponge is a living organism and that each species is specially adapted

to the particular set of natural conditions under which it grows are facts which are seldom absent from his mind, and as a consequence there is a freshness and reality about much which he has written that are often absent from the writings of the laboratory and museum worker.

Dr. Fowler's accounts of the Hydromedusæ and Scyphomedusæ are, in our opinion, the least satisfactory portions of the volume. The style is too concentrated and concise to make the writing effective, and intellectual interest has been entirely sacrificed in an attempt to introduce every available fact and to deposit it in a properly labelled compartment. The result resembles the syllabus of an advanced course of lectures on the groups dealt with rather than an intelligible account of those groups.

In the chapters on Anthozoa and Ctenophora, Mr. Bourne presents us with an excellent series of detailed descriptions of particular types, together with a clearly stated and well-marshalled body of facts concerning the groups as a whole. His work will undoubtedly prove of great value to both teachers and students. We, however, fail to find in these two sections that originality of treatment and originality of thought which characterise Prof. Minchin's section on the Porifera.

The whole work is well illustrated, being in this respect a great improvement on the volume of the treatise previously published (Part III. Echinoderma). The figures for which Prof. Minchin and Mr. Bourne are responsible, many of which are original, are specially worthy of praise.

THE GRAPHICAL MENSURATION OF VAULTS.

Il Calcolo Grafico applicato alla Misura delle Volte. Prof. Ernesto Breglia. 5th serie, vol. i. (Atti del Reale Istituto d'Incoraggiamento di Napoli, 1899.)

GRAPHICAL methods are used to a certain extent in the solution of engineering problems, although perhaps their employment is not so extended as their neatness and simplicity merit. In some cases, it is true, where the simplification is great and the application easy, they are used practically to the exclusion of other methods. But in other cases where a graphical treatment would effect almost as great a simplification the methods have never been very generally applied. The reason lies, we think, in the fact that it requires greater ingenuity to treat a problem graphically than analytically. Problems such as occur in practice, even though they may be complicated, can generally be hammered out by analytical means. A good mathematician, no doubt, will be able to find a short cut to the solution, but the engineer, whose ready stock of mathematical knowledge on which he can draw with ease amounts to little more than the algebra he learnt at school and an acquaintance with the principles of the calculus, will be able to work out the solution by dint of determined plodding. With graphical methods it is different. To begin with, the geometrical training which an English engineer receives at school is a hindrance rather than a help, so that when he comes to study graphical systems he finds himself in a region unknown to him and is obliged to disembarrass himself of the Euclidean notions acquired in his youth. We are afraid that the Englishman will never be quite happy in using geometrical methods until the groundwork of his knowledge is laid with some more suitable text-book than Euclid's Elements. In addition to this, with these methods each new problem requires somewhat different treatment; it is hard, and often impossible, to lay down very definitely the lines on which to proceed. The ingenuity which is consequently required can only be obtained, by any except the born mathematician, by the habitual use of the system.

Prof. E. Breglia's paper illustrates what we have been saying. The method that he has worked out for measuring the volumes of arches and vaults is extremely neat. In the simpler cases it is, as is natural, very much easier to follow and apply, and the ease of doing so is such that it should commend itself to all who have need to make such measurements. In the cases of vaults of more complicated shape the method becomes also more complex; artifices have to be used in order to "dodge" the more important difficulties. It is just these artifices that are so difficult to find when a new problem is attacked. To apply Prof. Breglia's method to the determination of the volume of a vault similar in shape to one of those he has examined in the paper before us would be fairly simple, even though the shape might be very complicated; to apply it to the case of a vault of quite a different shape would not be nearly so easy. Prof. Breglia has, however, examined a great variety of cases in a thorough manner, and has thus rendered his paper very valuable.

Prof. Breglia's system has other advantages besides a simplicity which enables the volume of a vault of complicated shape to be found without the use of advanced mathematics. The accuracy can be increased practically at will by varying the number of sections into which the vault is divided; with analytical methods high accuracy is often only attainable by undue complication of the mathematics. We are inclined to think, also, with Prof. Breglia that error is less likely to occur in its use, as should any mistake be made it will show itself directly; but this is an advantage that must not be given too great weight, as graphical methods possess possibilities of error, especially in the interpretation of the results, which are not to be met with in other methods. The system is, however, a very useful one, and the paper is worthy the careful attention of all those interested in the subject.

OUR BOOK SHELF.

Experimental Chemistry. By Lyman C. Newell, Ph.D. Pp. xv + 410. (Boston: Heath and Co., 1900.) Price 5*s*.

DR. NEWELL has added one more to the already formidable array of elementary science text-books, each of which, according to their respective authors, has been written to supply a long-felt need. In the present instance, the object is to promote the more efficient teaching of chemistry by modern methods; and in writing his book Dr. Newell has been actuated by "a desire to provide a course of study which shall be a judicious combination of the inductive and deductive methods."

We fail to see in what way Dr. Newell's book superior to a hundred others of a similar kind. The ideal that the author has set before him is a very high one, and we should be the last to deprecate any attempts to improve upon modern methods of teaching experimental science. It is obvious that the time at the disposal of the average student is so limited that it would be